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(54) IMPROVED PROCESS FOR THE PASTEURIZATION OF EGG WHITES

(71) We, STAUFFER CHEMICAL COMPANY, a corporation organised under the laws of the State of Delaware, United States of America, of 299 Park Avenue, New York, N.Y. 10017, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a process for the pasteurization of egg whites.

There are a number of food poisoning micro-organisms that cause serious problems in the food industry. Among these different spoilage organisms which may contaminate foodstuff, the group *Salmonellae* have gained special importance. *Salmonellae* are pathogenic gram-negative rod-like bacteria that have drawn much recent attention that is well documented in the literature. Of the several food areas involved, particular interest has been generated in the reduction of *Salmonellae* in egg products. The contents of an egg with unbroken shell may already contain bacteria caused by the infection of a laying hen. The exterior surface of the egg may be contaminated with bacteria from the intestinal tract of the hen, from the nest or from other material contacted after laying. Some of these can be introduced into egg products during breaking operations. Bacteria can also penetrate the shell from outside. The invading micro-organisms infect the egg and can be carried on into a variety of egg products.

The elimination of *Salmonellae* by pasteurization of egg products has become mandatory under United States Department of Agriculture regulations. According to these regulations all egg products have to be pasteurized regardless of whether they are to be distributed in frozen, liquid or dried form.

There are problems in pasteurization that are peculiar to egg whites as compared to whole eggs or yolks. All pasteurization processes for egg whites must be a compromise between the amount of heat applied to kill *Salmonellae* and the coagulation of the egg proteins, which effect the functional properties thereof. Although naturally occurring levels of *Salmonellae* are seldom greater than 100 per millilitre of egg product, present processes have need of improvement to minimize undesirable effects on functional properties or excessive build up on plant equipment. Present processes also lack retained inhibitory effects after pasteurization.

At present, there exist several processes which give acceptable destruction of *Salmonellae* in egg whites. One of these processes is described and claimed in U. S. Patent No. 3,251,697, which involves the addition of a food grade acid to lower the pH of the egg whites from about 9.0 to about 7.0, and the addition of aluminium or other metal ions to stabilize the egg proteins against coagulation at higher temperatures. These materials may be added to give a concentration of 30 parts per million as aluminium, added in the form of aluminium sulphate and 0.15% lactic acid in the egg whites. The egg whites may then be pasteurized at a temperature of 140 to 143°F., at a holding time of 3.5 minutes. This procedure is reported to destroy one million added *Salmonellae* per millilitre. However, it has been found in practice that the bacterial count in this process is relatively high after treatment. Also, the aluminium sulphate in the egg whites will cause the appearance of small particles of precipitated egg proteins.

Another proposed solution to killing the bacteria within the egg whites is described and claimed in U.S. Patent No. 2,776,214. This process involves taking the egg white at its normal pH, and heating it to 100° to 130°F. for a period of 0.5 to 5 minutes. This is claimed to largely inactivate the indigenous catalase. Thereafter, sufficient hydrogen peroxide solution is metered in to give a concentration of 0.1% peroxide in the egg whites. The egg whites are then reheated and they are cooled and catalase is added to destroy the residual peroxide. This process is reported to produce sterile egg white.

[*Price 5s. 0d. (25p)*]

This process has a serious drawback because a relatively high amount of bacteria may survive the pasteurization process when heat resistant bacteria strains are present in the egg whites.

It has been discovered that the number of *Salmonellae* bacteria killed during pasteurization thereof can be materially increased by incorporating within the egg whites an alkali agent to adjust the pH to at least from 0.5 to 1.5 units above the natural pH of the egg whites. Thereafter, the egg whites are heated to destroy the natural catalase and then a peroxide material is added in an amount ranging between about 0.01 to 1.5% by weight. The egg whites are then reheated to about 130°F. It has been found that the use of the alkali agent with the hydrogen peroxide materially increases the kill of the *Salmonellae* bacteria and also provides for residual killing thereof which is heretofore unknown.

The present invention provides a process for pasteurizing egg whites comprising raising the pH of the egg whites 0.5 to 1.5 units above the natural pH, heating the egg whites to destroy the natural catalase, adding at least 0.01% by weight of a peroxide material to the egg whites and heating the egg whites to pasteurize them.

In the practice of the present invention, egg whites are separated from yolk material in a conventional manner. As is well known, the pH of the egg whites is approximately 9.0. Then, an alkaline agent is added to adjust the pH of the egg whites to at least 0.5 to 1.5 units above the natural pH. The egg whites are then heated to about 130°F. for about 0.5 to 5 minutes. After the egg whites have been heated to this temperature, the natural catalase is destroyed. Then they are treated with hydrogen peroxide. The amount of hydrogen peroxide added may range between 0.01 to 1.5%, preferably about 0.05 to 0.5% by weight. Thereafter, the egg whites are heated to a temperature of about 115° to 130°F. for an additional 0.5 to 5 minutes.

The alkaline agent employed with the present invention may be sodium hydroxide, potassium hydroxide, sodium carbonate, ammonium hydroxide, calcium hydroxide, sodium phosphate, sodium bicarbonate or a mixture of two or more such alkalis.

By adjusting the pH of the egg whites with the alkaline agent as noted above, it has been found that the kill power of the additives along with the heat of pasteurization, materially increases the kill of the *Salmonellae* heretofore unknown. Also, the presence of the alkaline material within the eggs provides residual killing power of *Salmonellae* after the eggs have been cooled and the pH thereof readjusted to the natural level.

The invention will be further illustrated by the following examples:—

Example 1

Fresh egg whites were obtained in a hand operation by separating the egg whites from the yolks and mixing to form a uniform batch. The natural pH of the egg whites was determined to be 8.6. A bacteria culture of *Salmonellae senftenberg* 775W was added to the egg whites to provide a concentration thereof of 170,000 per millilitre of egg whites. Then, a 10% solution of sodium hydroxide was added thereto in a sufficient amount to raise the pH to 9.5. The egg whites were then heated for 1.5 minutes at 130°F. to destroy the natural catalase. Thereafter, hydrogen peroxide was added to the egg whites to provide a concentration of 0.1% by weight of the egg whites. The egg whites were then reheated to 130°F. for 3.5 minutes holding time. The egg whites were cooled quickly to 40°F. Catalase was then added to destroy the hydrogen peroxide. An assay of the egg whites in using standard microbiological procedures indicated that the sample was *Salmonellae* negative.

Example 2

The procedure as set forth in Example 1 was repeated in its entirety, except the sodium hydroxide additive was omitted. An assay of the pasteurized egg whites using standard microbiological procedures indicated a survival of 43 *Salmonellae* per millilitre of egg whites.

Example 3

The procedure as outlined in Example 1 was repeated in its entirety except the hydrogen peroxide and sodium hydroxide were both omitted. An assay of the egg whites indicated a survival of 1220 *Salmonellae* per millilitre of egg white using standard microbiological testing methods.

Example 4

Egg whites were obtained in a manner as set forth in Example 1. A bacterial culture of *Salmonellae senftenberg* 775W was added to provide a concentration thereof of 9.2 millions per millilitre of egg whites. Then, a 10% solution of sodium hydroxide was added dropwise to raise the pH from 8.6 to 9.5. After preheating the egg whites for 1.5 minutes at 130°F., 0.2% by weight hydrogen peroxide was added. The egg white was then heated to 130°F. for five minutes holding time. The pasteurized eggs were then assayed according to standard microbiological procedures, indicating *Salmonellae* negative.

Example 5

The procedure as outlined in Example 4 was repeated in its entirety except no hydrogen peroxide was added thereto. An assay of the pasteurized egg whites indicated a survival of 90 *Salmonellae* per millilitre of egg white.

Example 6

The procedure as outlined in Example 4 was repeated in its entirety except the addition of sodium hydroxide was omitted. An assay of the pasteurized egg whites indicated a survival of 50 *Salmonellae* per millilitre of egg white.

Example 7

The procedure as outlined in Example 4 was repeated in its entirety except the sodium hydroxide and hydrogen peroxide were omitted. The pasteurized egg whites were assayed in accordance with standard microbiological procedures indicating a survival of 190,000 *Salmonellae* per millilitre of egg white.

Example 8

Egg whites were obtained in a manner as set forth in Example 1. A bacterial culture of *Salmonellae typhimurium* was added thereto to provide a concentration of 74 millions per millilitre of egg white. Then, a solution of 10% potassium hydroxide was added dropwise to raise the pH of the egg whites to 9.2. The egg whites were heated to 128°F. for 1.5 minutes. Then, 0.2% by weight hydrogen peroxide was added to the egg whites. The egg whites were heated to 128°F. for 3.5 minutes holding time. After pasteurization, the egg whites were quickly cooled to 38°F. An assay of the pasteurized egg whites using standard microbiological techniques indicated *Salmonellae* negative.

Example 9

The procedure as outlined in Example 8 was repeated in its entirety except no additives were incorporated within the egg whites. An assay of the egg whites after pasteurization using standard microbiological procedures indicated a survival of 340,000 *Salmonellae* per millilitre.

Example 10

The functional properties of the pasteurized egg whites of Example 8 were tested. The functional properties are expressed by the specific volume of the whipped egg whites and by the specific volume of the cakes baked with the pasteurized egg whites. Under both criterias, the specific volume of the whipped egg whites and also of the cakes showed that the egg whites pasteurized with the additives of Example 8 are comparable to the functional properties of fresh egg whites indicating no damage in the functional properties.

Example 11

The pasteurized eggs of Example 1 were tested for any indication of an alteration of the functional properties. Accordingly, 176 grams of the egg whites were mixed with a kitchen style mixer for 90 seconds. The amount of foam thus generated was then measured. The quantity of foam produced is a measure of the degree of protein denaturization that may occur during pasteurization. The amount of foam produced by the egg whites in 90 seconds is inversely proportional to the amount of protein denaturized during pasteurization. The volume of foam produced under these conditions is reported as specific volume determined by dividing the total amount of foam generated in millilitres, by the weight of the egg whites in grams. Thus, the specific volume of less than 3 indicates an excessive denaturization of the egg whites that is undesirable. The egg whites treated as set forth above had a specific volume of 6.3. After the specific volume of the egg whites had been measured, the baking performance thereof was measured by preparing angel food cake from the pasteurized egg whites. Thus, the 176 grams of egg whites were beat for an additional two minutes with the kitchen style mixer. Thereafter, 2.45 grams of cream of tartar, 0.70 grams of salt, and 84.0 grams of sugar were added. The mixture was then blended for an additional two minutes. Then, a blend consisting of 42 grams of flour and 45 grams of sugar was folded into the whipped egg whites. The resulting batter was placed in six inch pans and baked for 30 minutes at 355°F. After baking, the volume of the cakes were measured by standard seed displacement techniques. The specific volumes were determined by dividing the weight of the cakes in grams into the total volume. A specific volume greater than 3 is indicative of acceptable egg white functional properties. In this instance, the specific volume was 4.4. Any changes in opacity of the egg whites due to pasteurization was measured by visual observation. An increase in opacity of the formation of solid protein particles is indicative of protein denaturization. The egg whites pasteurized in accordance with this invention were clear.

Example 12

The pasteurized egg whites of Examples 1 to 9 were assayed for bacterial flora count using standard microbiological procedures. The pasteurized egg whites were then stored at room temperature. At 24 hour intervals, the bacterial flora count was re-evaluated for three consecutive days. The egg whites as pasteurized in accordance with Examples 1, 4 and 8 indicated a decrease in bacterial flora count while all the other pasteurized egg whites indicated an increase in bacterial flora count.

WHAT WE CLAIM IS:

1. A process for pasteurizing egg whites comprising raising the pH of the egg whites 0.5 to 1.5 units above the natural pH, heating the egg whites to destroy the natural catalase adding at least 0.01% by weight of a peroxide material to the egg whites and re-heating the egg whites to pasteurize them.

2. A process as claimed in claim 1, in which the pH of the egg whites is raised with a food grade alkaline material.

3. A process as claimed in claim 1 or claim 2 in which the alkaline material is sodium hydroxide, potassium hydroxide, sodium carbonate, ammonium hydroxide, calcium hydroxide, sodium phosphate, sodium bicarbonate or a mixture of two or more such alkalis.

4. A process as claimed in claim 1, in which the egg whites are heated to a temperature of from 115° to 130°F.

5. A process as claimed in claim 4, in which the temperature is maintained for from 0.5 to 5 minutes.

6. A process as claimed in claim 1, in which the peroxide is present in an amount from 0.01 to 1.5% by weight.

7. A process as claimed in claim 1, in which the reheating temperature is from 115° to 130°F.

8. A process as claimed in claim 7, in which the reheating temperature is maintained for from 0.5 to 5 minutes.

9. A process as claimed in claim 1, together with the additional steps of subsequently cooling the egg whites and readjusting the pH thereof to its natural level.

10. A process as claimed in claim 1 substantially as herein described with reference to Examples 1 to 4 and 8.

11. Egg whites when prepared by a process as claimed in any of claims 1 to 10.

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